

REMARKS

Claims 1-23 are pending in the application.

Claims 1, 20, 22, and 23 are amended to specify that the microstructure parts (6) are in direct contact with the mixing zone (5) but not in direct contact with said at least one inlet opening (2). Support for the amendment may be found in Figures 1-9 the drawings as originally filed.

No new matter is added.

Claims Rejections 35 U.S.C. 112, second paragraph

Claims 1-23 are rejected under 35 U.S.C. 112, second paragraph over the alleged indefiniteness of the term “contact” as it applies to the positional relationships between microstructure parts, the inlet opening, and the mixing zone. Applicant argues that the claims are not indefinite when the term “in contact with” is given its normal and everyday meaning and that the metes and bounds of the rejected claims are clear to one of skill in the art when read in view of the specification without reading limitations from the specification into the claims. Nevertheless, and solely to advance the prosecution of the present application, claims 1, 20, 22, and 23 are amended to consistently recite microstructure parts that are in direct contact with the mixing zone and not in direct contact with the inlet opening.

In view of the amendment to claims, Applicant respectfully requests that the rejection of claims 1-23 as being indefinite under 35 U.S.C. 112, second paragraph be withdrawn.

Claims Rejections 35 U.S.C. 103

Claims 1-23 remain rejected under 35 U.S.C. 103(a) as being unpatentable over **Hemming** (ISBN 3-8023-0084-X, pp158-9) in view of **Schubert** et al. (US 6,082,891) and in further view of **Ehrfeld** et al. (US 2003/0039169). The Examiner's rejection has been carefully considered.

The rejection cites Hemming only as teaching the general process for extraction using at least two immiscible fluids. Hemming does not teach or suggest a micromixer or any structural components for a micromixer.

The rejection cites Schubert as teaching a micromixer having the structural elements recited in the rejected claims for a micromixer.

The rejection cites Ehrfeld as teaching micromixer components in the form a disk and asserts that one of ordinary skill would have been motivated to modify Schubert in view of Ehrfeld to make the Schubert micromixer in the form of disk-shaped components rather than polygonal-shaped components.

I A. Regarding claims 1, 22, and 23, Applicant argues that the cited references, neither individually nor in combination, teach or suggest every limitation recited in claims 1, 20, and 22, as amended. Specifically, none of the references teach or suggest: [1] microstructure parts (6) that divide a (i.e. single) linking channel into more than two part channels immediately before opening into a single mixing zone; [2] a (i.e. single) linking channel that is divided only once immediately before opening into a single mixing zone; or [3] microstructure parts dividing a (i.e. single) linking channel wherein the microstructure parts are in direct contact with the mixing zone but not in direct contact with the inlet opening.

Initially, Applicant notes that the rejection does not address the limitation that the microstructure parts dividing the linking channel into part channels is not in contact with the inlet opening or in direct contact with the inlet opening.

Regarding Schubert, it appears that the rejection equates admission chamber 7A (or at least the portion of the admission chamber that is in the plane of the plate) with inlet opening (2) recited in the rejected claims. The parallel grooves 2A and 2B (or parallel passages 3A,4B) in Schubert appear to be interpreted as equivalent to both the part channels (7) and linking channels (3) recited in the rejected claims. If this is the case, the interpretation contradicts the plain meaning of separating a (i.e. single) channel into two or more part channels.

Contrary to a single linking channel separated by microstructure parts into part channels, Schubert teaches multiple, parallel passages of equal length connecting an inlet and an outlet. Schubert, C2/L40-61 cited in the rejection, teaches "*a number of arc-like grooves 2A, 2B*" pressed into a foil and arranged to be closely adjacent to one another. When foils are stacked, rows of passages 3A and 4B are formed. The set of grooves 2A "*extends in the shape of an arc from the right rear face 6A to the center area 6C of the front face 8A of the foil 1A.*" 6A is a flat face in direct contact with fluid admission chamber 7A (FIG. 2). Viewing FIG. 1, it is clear that Schubert teaches multiple, parallel channels linking a fluid inlet with a mixing zone and not a linking channel divided by microstructure units immediately prior to opening into the mixing zone. This interpretation is entirely supported in C2/L10-24.

It appears that the outstanding rejection may be based, in part, on an interpretation that the microstructure parts (6) recited in the rejected claims encompass the walls of the separate, parallel linking channels in Schubert. Such an interpretation would be incorrect based solely upon the language recited in the rejected claims. Additionally, while limitations are not to be read from the specification into the claims, the claims are not to be interpreted in a vacuum. One of skill in the art would clearly not confuse the linking channel separated into part channels by microstructure parts recited

in the rejected claims with the multiple, separate, parallel, arc-shaped channels of equal lengths between an inlet opening 7A and a mixing zone 9C taught by Schubert.

In response to the foregoing argument as presented in the amendment filed 05/28/2010, the Examiner refers Applicant to an annotated version of FIG. 2 from Schubert on page 5 of the Office Action mailed 08/17/2010. Applicant appreciates the Examiner's time and effort to clearly articulate the response in this way.

The annotated version of Fig. 2 clearly illustrates a number of errors in the Examiner's interpretation of Schubert. For example, the Examiner asserts that inlet openings are "*not explicitly shown*" and "*must inherently exist.*" From this interpretation, it follows that the linking channel and the inlet opening to the linking channel recited in the rejected claims are one and the same. This is in complete contradiction to the plain meanings of the words "channel" and "inlet opening" into a channel. According to the plain meanings of the words, a channel with an inlet opening cannot be interpreted to mean a single void in the planar structure shown in FIG. 2 in Schubert.

In the description of FIG. 2, column 3, lines 7-12, Schubert discloses that guide structure 6 has a "*series of arc-like curved passages 3A and 4B leading alternately from admission chambers 7A and 7B to the mixing chamber 9C...*" Schubert explicitly and unequivocally discloses a series of passages connecting an admission chamber to a mixing chamber. It follows, therefore, that each passage has an inlet in fluid communication with an admission chamber and an outlet in fluid communication with a mixing chamber. Each passage is an undivided passage from the admission chamber to the mixing chamber. Additionally, it is clear from the annotated figure that the inlet openings to the passages are not disposed in the plane of the plate (disk).

Figure 2 and its description in Schubert provides no basis whatsoever for an inferred inlet opening because there are no structures to form an inlet opening. Asserting that such an inlet is inherent without structure would necessarily result in an interpretation in which 7A is simultaneously interpreted as an admission chamber, an

inlet opening, and a linking channel. That a single enclosed space with no internal structures could be considered as three separate structures is simply not reasonable.

The reasonable interpretation of Figure 2 in Schubert is the one clearly presented in the reference itself. That the inlet opening, linking channel, part channels, and microstructure parts recited in the rejected claims are equivalent to an admission chamber separated from a mixing chamber only by a series of undivided passages of equal length is not a reasonable interpretation of the rejected claims or of the Schubert reference.

I B. Applicant argues that one of ordinary skill in the art, at the time the invention was made, would not have been motivated to modify the combined teachings of Hemming and Schubert according to the teachings of Ehrfeld, as suggested in the rejection.

The rejection asserts that it would have been obvious to modify the plate of Schubert to include a disk shape as opposed to a polygonal shape, since doing (so) amounts to nothing more than the substitution of one plate design for another, both of which are recognized in the art of micromixers." Setting the lack of motivation for the asserted substitution of shapes aside, the suggested modification of the Schubert plates to be disk-shaped rather than pentagonally shaped would render the Schubert invention inoperable for its intended purpose because the resulting geometry would be incompatible with the requirement (according to Schubert) for a pentagonal shape and flat faces where the passages meet inlets and mixing zones to maintain rows of parallel, arced passages that are of equal length (C2/L53-C3L32). This is supported by C3/L39-52, which provides the only description of manufacturing the plates for the Schubert micromixer and which describes the manufacture of pentagonal plates (see also FIG. 3). Furthermore, the specific geometry used by Schubert is taught by Schubert as having the advantage of achieving a packing density of passage openings of several thousand per square centimeter (C2/L 10-24).

In response to the immediately preceding argument in the amendment filed 05/28/2010, the Examiner asserts that [1] the reference does not explicitly state that other shapes would be able to achieve the advantages of a high packing density; [2] changing the shape of the plate from pentagonal to disk (i.e. circular) would not necessarily destroy the operability of the micromixer device; [3] the disk shape is not critical to Ehrfeld.

Regarding [1] and whether non-pentagonal shapes would have been able to achieve the advantages of high packing density, column 2, lines 2-24, in Schubert teaches that the structure of the flow guide forms curved, parallel passages, all having the same length and that the passages lead fluid into the mixing chamber to obtain uniform mixing over the whole passage outlet area with no unused clearance volumes in the guide structure. The packing density of passage openings of the invention is several thousand openings per square centimeter. The correlation between pentagonal shape and curved, parallel passages, all having the same length is further supported in Column 3, lines 7-32 (see [2] below). Schubert therefore teaches the correlation between the structure of the curved channels of equal length and the density of channel openings. Applicant has made reference to specific citations in Schubert to support the argument that Schubert teaches a correlation between the pentagonal structure of the plates and their function. Applicant respectfully submits that the Examiner's response does not address the substance of the citations presented by Applicant and that the assertion made in Examiner's response lacks any citation supporting it.

Regarding [2] and whether changing the shape of the Schubert plate from pentagonal to disk would destroy the operability of the micromixer device, column 3, lines 7-32 in Schubert provides support for Applicant's argument:

The leg face areas **6A**, **6B** are inclined with respect to the face area **8** or, respectively, the side surfaces **10**, **11** of the guide structure **6** such that the series of arc-like curved passages **3A** and **4B** leading alternately from the admission chambers **7A** and **7B** to the mixing chamber **9C** have approximately all the same length.

For the circular grooves or passages consequently the arc length should be constant:

$$L = \frac{2\pi r \cdot \alpha}{360} = \text{constant}$$

wherein r is the respective radius of curvature and α is the respective arc angle of the particular grooves or passages. Such a requirement would lead to curved face areas **6A** and **6B**. However, approximated flat face areas are substituted using, for example, the approximation rule:

$$\frac{\alpha_2}{\alpha_1} = \frac{r_1}{r_2}$$

wherein r_1 represents the largest and r_2 represents the smallest radius and α_1 and α_2 represent the corresponding arc angles of the outermost and the innermost grooves.

After the foils **1A**, **1B** are stacked on top of one another, they are provided with cover plates **15** and interconnected in a vacuum and pressure-tight manner, for example, by diffusion welding so that the guide structure **6** formed thereby becomes a homogeneous microstructure body which is then connected to the chambers **7A**, **7B** and **9C**.

Here, Schubert clearly teaches that the shape of the grooves to form circular, parallel channels, all of equal length is critical to the intended use of the Schubert static micromixer. Starting at line 22, Schubert teaches that the requirement for circular passages with constant arc lengths would (otherwise) lead to curved face areas **6A** and **6B** but that approximated flat face areas are substituted (for curved face areas) by using an approximation rule. The pentagonal shape is, according to Schubert, critical to the intended purpose of the micromixer. Schubert does not teach or suggest that the pentagonal shape is preferred because that shape is easier to manufacture than other shapes. In fact, the pentagonal shapes are formed from starting material that has a disk

shape. Applicant has made reference to specific passages in Schubert in support of the argument that the pentagonal shape of the guide structure plates is critical to for the guide plates to operate as Schubert intends. Applicant respectfully submits that the Examiner's assertions to the contrary, lacking any supporting reference or citation, do not address the arguments raised in Applicant's arguments made 05/28/2010.

Regarding [3] and whether the disk shape is critical to Ehrfeld, Applicant respectfully points out that Ehrfeld is cited in the rejection as providing a motivation for changing the shape of the Schubert plate from pentagonal to circular (i.e. a disk). Consequently, it makes no difference whether the disk shape is required for the function of the Ehrfeld micromixer.

The argument made by Applicant, which is not addressed in the Examiner's response, is that Ehrfeld teaches a micromixer that requires a specific linking channel geometry that correlates with the function of providing identical volumetric flows for each fluid at the respective microchannel outflows (abstract, [0012], [0051]). This is accomplished by a minimal sequential bifurcation that has two stages of bifurcation. This means that Ehrfeld has one inlet opening and at least four outlet openings for transferring fluid to the mixing chamber. Identical flow volumes are critical to Ehrfeld and are accomplished by sequential bifurcation. This leaves a great deal of "dead space" that is not compatible with a high packing density for outlet openings. High density outlet openings and uniform mixing over the entire outlet surface are critical to the Schubert mixer. This is accomplished by parallel, unbranched, curved passages all having the same length. One of ordinary skill in the art would have had no reason to modify Schubert according to Ehrfeld to make disk-shaped plates because the change from a pentagonal shaoe to a circular one would render the Schubert micromixer inoperable for its intended purpose. It would still function as a micromixer of some sort, but it would no longer function as intended. Furthermore, one of ordinary skill in the art would not have been motivated to modify Ehrfeld according to Schubert to replace the bifurcating passages with parallel, unbranched, curved passages all having the same

length because there would have been no reason to believe that this would result in identical flow volumes for all of the passages.

II. Regarding claim 2, Applicant notes that claim 2 depends from claim 1 and is therefore patentable for at least the reasons articulated in the arguments against the rejection of claim 1. Additionally, the rejection cites FIGs. 1 and 2 and column 3, lines 3-33 as supporting the assertion that Schubert teaches a housing having 2 fluid inlets, at least one fluid outlet, and two or more components in the form of a disk arranged into a stack. The citations teach the stacking of two plates on one another, but not disks.

III. Applicant argues that claim 3, depending from claims 2 and 1, is patentable at least for the reasons articulated hereinabove and, additionally, that one would not have been motivated to modify Schubert to have subsidiary channels according to Ehrfeld. The rejection provides no assertion of obviousness or reason for combining the references as asserted.

IV. Regarding claim 4, Applicant argues that the claim is patentable at least for the reasons articulated for claim 3, from which claim 4 depends. Additionally, Applicant argues that the rejection of claim 4 is in error because it does not address the limitation that the extracting fluid is introduced into the main channel (as opposed to being introduced via a subsidiary channel). The rejection merely asserts that it would be inherent for the substance being extracted and the extraction agent to flow from the subsidiary channels into the main channel.

V. Regarding claim 5, Applicant argues that claim 5 is patentable at least for the reasons articulated for claim 1. Additionally, Applicant argues that Schubert does not teach or suggest part channels as recited in present claim 1. Column 2, lines 49-62, clearly teach that the grooves and passages all extend from the mixing zone face of the guide structure to the admission chamber face of the guide structure.

VI. Regarding claim 6, Applicant argues that, in addition to the reasons articulated with respect to claim 1, if the fluid admission chamber is equated with both the presently claimed linking channel and the presently claimed inlet opening, a ratio between their widths cannot exist. Additionally, the rejection language makes no grammatical sense. No coherent correlation between actual structures in Schubert and structures recited in claim 6 is articulated.

VII. Regarding claims 7, 8, and 21, Applicant argues that the rejection does not articulate what in Schubert allegedly corresponds to the length or width of a “part channel” or even what structures in Schubert are considered to be “part channels.”

VIII. Regarding claims 9, 10, 16, and 17, Applicant argues that the interpretation of the Schubert micromixer used to reject claims 9, 10, 16, and 17 directly contradicts the interpretation of the Schubert micromixer used to reject claim 1. The rejection of claims 9 and 10 is grammatically difficult to follow and cites “figure 3a” but it appears to assert that Schubert teaches a linking channel formed by an indentation. In the rejection of claim 1, the rejection asserts that the linking channel in Schubert is the void space on the inlet side of the passages, which are asserted to be equivalent to the presently claimed microstructure parts. It appears that the Examiner’s interpretation of the Schubert reference differs depending on the claim being rejected and is internally inconsistent. Accordingly, Applicant argues that implied motivation for combining references cited in the rejection of claims 9 and 10 is the result of hindsight reconstruction. Additionally, claims 16 and 17 depend from claim 3, for which no motivation to combine references is provided.

IX. Regarding claim 11, which depends from claim 1, Applicant argues that the rejection fails to establish prima facie obviousness because the rejection only asserts that it would have been obvious to modify inlet openings in the Ehrfeld micromixer. The rejection of claim 1 cites Ehrfeld only as teaching a disk shape rather than a pentagonal shape. The rejection of claim 1 relies on Schubert for teaching passages, inlets, and

outlets. The rejection of claim 1 does not assert that it would have been obvious to modify Schubert according to Ehrfeld to use the passages or inlet openings taught by Ehrfeld. Consequently, the rejection of claim 11 lacks support for including the inlet openings of Ehrfeld at all, let alone any modification of the inlets.

X. Regarding the rejection of claims 12-15, Applicant points out that claims 12-15 each depend from claim 1. The rejection of claim 1 asserts that it would have been obvious to modify the micromixer of Schubert according to Ehrfeld to make the Schubert plate in the form of a disk. The rejection relies on Schubert to teach the asserted configurations of passages, inlet and outlet openings, part channels, through holes, etc. The rejections of claims 12-15 rely on modifications of the passages, inlet and outlet openings as taught by Ehrfeld. Consequently, the rejection fails to establish *prima facie* obviousness.

XI. Regarding the rejection of claims 18 and 19, Applicant argues that the assertions made in the rejection are not accurate. The rejection asserts that the flow rate of a fluid stream exiting narrow channel into a "large chamber" (presumably the mixing zone) inherently decreases. This is not correct because the flow of fluid within the mixing zone can depend upon the flow rate of fluid through the main channel of the mixing zone. The rejection erroneously assumes that no fluid is flowing through the main channel with a flow velocity greater than the velocity of fluid flow from the outlet openings. The rejection also incorrectly asserts that turbulent mixing is inherent because the rejection erroneously assumes that the flow rates of the fluid streams must be sufficient for causing turbulent mixing.

In view of the foregoing arguments and the amendment to claims 1, 20, and 22, Applicant respectfully requests that the rejection of claims 1-23 under 35 U.S.C. 103(a) as being unpatentable over Hemming in view of Schubert and Ehrfeld be withdrawn. Should the rejection of claims 1-23 be maintained, Applicant respectfully requests that the Examiner articulate exactly which elements in Schubert correspond with each of the elements recited in the rejected claims.

Finality of the Office Action Should be Withdrawn

Applicant respectfully requests that the finality of the Office Action mailed 08/17/2010 be withdrawn because the Examiner maintained rejections of claims under 35 U.S.C. 103(a) without articulating responses to all Applicant's arguments made in the amendment filed 05/28/2010. In particular, the Response to Applicant's Arguments did not address specific citations to the reference art made in Applicant's arguments.

Conclusion

The application in its amended state is believed to be in condition for allowance. Action to this end is courteously solicited. Should the Examiner have any further comments or suggestions, the undersigned would very much welcome a telephone call in order to discuss appropriate claim language that will place the application into condition for allowance.

Respectfully Submitted,



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